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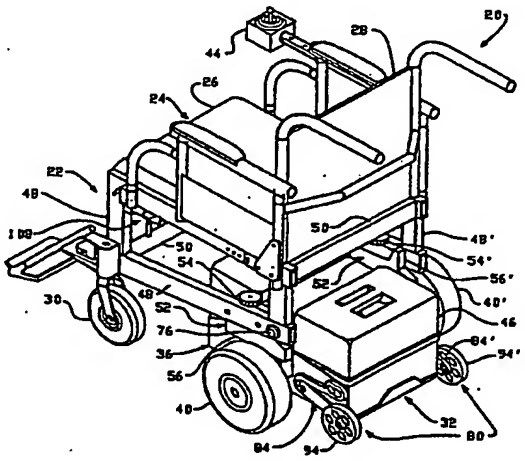

(57) Abstract

A wheelchair (20) including a wheelchair frame (22) and a seat assembly (24) carried by the wheelchair frame (22). A detachable power drive assembly (32) having power driven wheels (40, 40') is releasably coupled to the wheelchair frame (22) and is mounted for selective removal of the drive assembly (32) as a unit from the wheelchair frame (22). Wheel mounting ports (76, 76') are also provided in the wheelchair frame (22) for releasably receiving a pair of manually-operable drive wheels (34, 34'). An anti-tip suspension (80) is also provided and includes a suspension arm (84) which is mounted to resist rearward tipping of the wheelchair by a non-linear restoring force. A wheel lock (108) is mounted for movement between a deployed operable position and a stored inoperable position. In the deployed position, the wheel lock (108) extends laterally outwardly of the wheelchair frame (22) for engagement with and braking of manually operable drive wheels (34, 34').

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POWERED WHEELCHAIR WITH A DETACHABLE POWER DRIVE ASSEMBLY

TECHNICAL FIELD

The present invention relates, generally, to wheelchairs and, more particularly, to wheelchairs including power drive assemblies.

BACKGROUND ART

Wheelchairs have been primarily designed to provide transportation for the physically impaired, often emphasizing user comfort, portability and flexibility. Because of the individual needs and requirements of the wheelchair occupants, however, a variety of styles and shapes have been developed which cater to their specific needs. Moreover, most of these styles and shapes include power driven counterparts which, of course, are highly desirable.

Powered wheelchairs generally include an electric powered drive assembly having a drive assembly support structure which forms an integral portion of a wheelchair support frame. Typically, the drive assembly includes an electric motor and battery, each of which are generally mounted to the drive assembly support structure. At least two power driven wheels, supported by the wheelchair support frame, are rotatably coupled to the motor and engage the ground to propel the wheelchair. Furthermore, the wheelchair support frame carries a seat support assembly including

a seat and a backrest. The drive assembly is usually operably coupled to a joystick which permits the user to control the direction of travel of the powered wheelchair from the user operational position.

While powered wheelchairs are highly advantageous in many situations, manually propelled or operated wheelchairs also can have many advantages. Moreover, if the drive assembly of a powered wheelchair should malfunction, for whatever cause, the wheelchair occupant may be left without a functional wheelchair for the duration of the repair period. Usually, the motor and/or batteries are individually mounted to the drive assembly support structure which, in turn, is integrally mounted to the wheelchair support frame. Repair of the damaged components often requires complete removal from the drive assembly support structure, and hence, the wheelchair support frame which involves a complex task reserved for the skilled technician. Moreover, removal of the complete drive assembly may require a piecemeal removal of each drive component. That is, the drive assembly cannot be readily removed from the wheelchair support frame as an independent unit. Thus, the whole wheelchair apparatus must be brought in for repair. During this repair time, the wheelchair user may be without recourse.

Typical of such prior art powered wheelchair assemblies are the wheelchairs disclosed in U.S. Patent No. 5,022,476 to Weege; U.S. Patent No. 4,961,473 to Jones; U.S. Patent No. 4,805,712 to Singleton; and U.S. Patent No. 4,341,278 to Meyer, each of which describes an electric powered wheelchair having a drive assembly support structure forming an integral part of the wheelchair support frame.

Attempts have been made to modularize the drive assembly to aid removal of the components. U.S. Patent No. 4,967,864 to Boyer et al. discloses a powered wheelchair apparatus having modularized individual components formed for easier removal from the drive assembly. While the Boyer wheelchair may facilitate removal of the individual components, the drive assembly, as a unit, is not removable.

Still other attempts have been made to retrofit independent electric drive units to manually operable wheelchairs. U.S. Patent No. 4,967,865 and U.S. Patent No. 4,386,674 to Coker disclose detachable electric drive units mountable proximate a front portion of the wheelchair. This device however, poses several problems. The forward mounting of the drive unit severely hampers the user's entry and exit of the wheelchair when the drive unit is installed, as well as impedes the movement of the user once situated in the operating position. This problem can be magnified for those users severely impaired. Additionally, the pivotal motion of the steering precludes the effective use of footrests for the occupant.

Moreover, powered wheelchairs are often bulkier and substantially heavier than their manually operated counterparts. The weight of the motor, in addition to the battery, can be significant. A battery alone may weigh in excess of 20 lbs. Moreover, two batteries are necessary in most instances. The wheelchair support frame must also be designed to accommodate this additional weight which itself adds weight. Thus, wheelchair users often prefer manually operable wheelchairs for home use. The additional bulkiness of powered wheelchairs impairs maneuverability inside close quarters. Further, the power driven wheels together with the additional weight can wear or damage

the floors and rugs of a home. Accordingly, it is highly advantageous for the user of a powered wheelchair to also own a manually operated wheelchair for home use. Unfortunately, this requires the wheelchair user to have two wheelchairs at his or her disposal, which is costly and requires storage space.

Additionally, if the wheelchair user has only a powered chair, when drive assembly malfunctions occur, the wheelchair must be pushed about manually. This task is cumbersome and requires assistance because of the additional weight of the powered chair and the lack of user operable drive wheels. Thus, dual usage of a powered wheelchair as both a powered and a manually operated chair has not been practical.

Another problem associated with powered wheelchairs is that they are not as portable as manual wheelchairs. Manually operated wheelchairs are much easier to transport in automobiles because they often do not require any special vehicle modifications or accommodations. The collapsibility of many manually operated wheelchairs makes them particularly suitable for portability in vehicles. In contrast, most powered wheelchairs, because of the integral mounting of the drive assembly onto the support frame, occupy substantially more space and are usually not a collapsible as their manually operated counterparts. Moreover, the additional weight a powered wheelchair carries substantially impedes the lifting of the wheelchair into vehicles. Often special vans or automobiles having modified exteriors and interiors are necessary to lift and transport powered wheelchairs.

Still other problems associated with powered wheelchairs are that they have a tendency to tip backwards upon initial acceleration. The torque

generated by the motor is often substantial and the unwary user may tip over. In light of this problem, anti-tip caster wheels are often provided rearward of the drive wheels. These caster wheels often are mounted on arms rigidly coupled to the support frame and are angled downward to a level just above the ground. As the wheelchair begins to tip backward, the anti-tip caster wheels engage the ground to prevent further tipping. Typical of this type of structure is the wheelchair of U.S. Patent No. 4,721,321 to Haury et al.

While these anti-tip mechanisms have successfully prevented rearward tipping of the wheelchair apparatus in most instances, the rigid coupling of the anti-tip wheel to the support frame provides a fairly abrupt jolt to the wheelchair occupant as the anti-tip wheel engages the ground. In one instance, the occupant's momentum is pivoting rearward about the drive wheel axis; in another instance the occupant's momentum is shifted forward as the anti-tip wheel engages the ground. This momentum shift may jolt the occupant which can be physically tolling, particularly on those severely impaired.

Accordingly, it is an object of the present invention to provide a wheelchair apparatus which is operable as both a powered and a manually movable wheelchair.

Another object of the present invention is to provide a wheelchair apparatus with a removably mounted drive assembly.

It is another object of the present invention to provide a powered wheelchair apparatus which is more portable.

Still another object of the present invention is to provide a powered wheelchair apparatus which lowers the composite center of gravity.

Yet another object of the present invention is to provide a progressively rated anti-tipping suspension to a wheelchair apparatus.

It is a further object of the present invention to provide a wheelchair apparatus which is durable, compact, easy to maintain, has a minimum number of components, is easy to use by unskilled personnel, and is economical to manufacture.

The apparatus and method of the present invention has other objects and features of advantage which will be more readily apparent from the following description of the Best Mode of Carrying Out the Invention and the appended claims, when taken in conjunction with the accompanying drawing.

DISCLOSURE OF INVENTION

The present invention includes a wheelchair comprising a wheelchair frame having a fore and an aft portion, and a seat assembly carried by the wheelchair frame. The wheelchair further includes power drive assembly with a drive assembly frame and a motor mounted to the drive assembly frame. Power drive wheels also are mounted to the drive assembly frame and are operably coupled to the motor. A drive assembly mounting mechanism releasably couples the drive assembly frame to the wheelchair frame proximate the aft portion of the wheelchair frame for driving of the wheelchair as a powered wheelchair and for selective removal of the power drive assembly as a unit from the wheelchair frame. Wheel mounting assemblies are also provided on the wheelchair frame to releasably receive a pair of

manually-operable drive wheels. These drive wheels permit manual operation of the wheelchair apparatus when the power drive assembly is removed from the wheelchair frame.

In another aspect of the present invention an anti-tip suspension for the wheelchair is provided comprising a suspension arm assembly having a mounting mechanism for pivotally mounting the arm assembly to the wheelchair frame. The arm assembly includes a first arm portion which extends away from the mounting mechanism. A ground engaging device is provided on the first arm portion at a spaced distance from the mounting mechanism. Furthermore, the suspension arm assembly includes a pivotal motion resisting mechanism which resists pivoting of the first arm portion about the mounting mechanism when the wheelchair is tipped by an amount sufficient to cause the ground engaging device to contact the ground.

In yet another aspect of the present invention, a wheel lock assembly for a wheelchair is provided mounted to the wheelchair frame and formed to engage at least one of the manually-operable drive wheels to effect locking of the wheels thereof. The wheel lock assembly is mounted for movement between a deployed operable position and a stored inoperable position. In the deployed operable position, the wheel lock assembly extends laterally outwardly of the wheelchair frame by an amount enabling frictional engagement by the wheel lock assembly with one of the manually-operable drive wheels to effect braking thereof. In the stored position, the parking brake assembly is located laterally inwardly of the wheelchair frame.

These and other features and advantages of the present invention will become more apparent from the following

description of exemplary embodiment thereof, as illustrated in the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIGURE 1 is a top perspective view of a wheelchair apparatus constructed in accordance with the present invention and including a detachable power assembly.

FIGURE 2 is a schematic, top perspective view of the wheelchair apparatus of FIGURE 1 with the power assembly removed and manually-operable wheels mounted thereto.

FIGURE 3 is an enlarged, top perspective view of the detachable drive assembly constructed in accordance with the present invention.

FIGURE 4 is a top plan view of the detachable drive assembly of FIGURE 3.

FIGURE 5 is a rear elevation view of the detachable power assembly of FIGURE 3 and illustrating the mounting spacers.

FIGURE 6 is a fragmentary, enlarged, schematic side elevation view of the detachable drive assembly mounting mechanism.

FIGURE 7 is an enlarged, side elevation view of the anti-tip suspension designed in accordance with the present invention.

FIGURE 8 is an enlarged, top perspective view of the manual wheel lock assembly constructed in accordance with the present invention and illustrating a "deployed" position.

FIGURE 9 is a top perspective view of the manual wheel lock assembly of FIGURE 8 and illustrating a "stored" position.

FIGURE 10 is a side elevation view, partially broken away, of the manual wheel lock assembly of FIGURE 8 and showing the spring assembly.

BEST MODE OF CARRYING OUT THE INVENTION

The wheelchair apparatus of the present invention includes a detachable drive assembly removably mounted to a wheelchair frame. The drive assembly is detachable as an independent unit from the wheelchair frame so that the wheelchair apparatus may be manually operable. The following description is presented to enable a person skilled in the art to make and use the invention, and is provided in the context of a particular application and its requirements. Various modifications to the preferred embodiment will be readily apparent to those skilled in the art, and the generic principles defined herein may be applied to other embodiments and applications without departing from the spirit and scope of the invention. Thus, the present invention is not intended to be limited to the embodiment shown, but is to be accorded with the widest scope consistent with the principles and features disclosed herein.

It will be noted here that for a better understanding, like components are designated by like reference numerals throughout the various figures. Attention is now directed to FIGURE 1, where the subject wheelchair apparatus, generally designated 20, is illustrated. Assembly 20, briefly, comprises a wheelchair frame means, generally designated 22, which carries a seat assembly 24 having a seat member 26 and a backrest member 28. A pair of front caster wheels 30 are

pivotally mounted proximate a fore portion of wheelchair frame means 22 which provide support and aid steering. Detachably mounted proximate an aft portion of frame means 22 is an independent power drive assembly unit, generally designated 32, which provides powered mobility to wheelchair apparatus 20.

As will be described in greater detail below, drive assembly 32 is removably mounted proximate the aft portion of wheelchair frame means 22 and operates as a rear wheel drive mechanism for wheelchair apparatus 20. Drive assembly 32 is fully independent of frame means 22 and is formed for selective removal as a unit. When drive assembly 32 is detached from wheelchair frame means 22, manually-operable wheels, generally designated 34 and 34', may be removably mounted directly to frame means 22, as illustrated in FIGURE 2. Therefore, wheelchair apparatus is fully operable as either a powered wheelchair (FIGURE 1), or a manually-operable wheelchair (FIGURE 2) wherein wheelchair frame means 22 is free of any power drive assembly components.

The detachable power assembly configuration of the present invention is highly beneficial for numerous reasons. For example, this construction affords enhanced portability of the wheelchair apparatus, facilitates repair of the drive assembly, and eliminates the need to have more than one wheelchair. Transportation of wheelchair apparatus 20 is facilitated by the removal of power drive assembly 32 as an independent unit. The current commercially available powered wheelchairs, where the drive assemblies are not removable as a unit, are often too heavy to lift as a whole or would require substantial disassembly to remove the integrally mounted drive unit. In contrast, removal of power drive assembly 32

in accordance with the present invention, a fairly simple procedure. Once removed, the weight of wheelchair apparatus 20 is substantially reduced so that it may be more easily lifted or moved. Similarly, drive assembly 32, once removed from the main wheelchair frame, is lighter and less bulky. This detachable construction, therefore, greatly eases wheelchair portability.

Furthermore, should power drive assembly 32 malfunction, it can easily be detached from wheelchair frame means 22 and independently brought to a shop for repair as a unit, rather than requiring the whole wheelchair apparatus 20 to be brought into the shop. Moreover, power drive assemblies 32 can be interchangeable so that should the individual's power drive assembly 32 need repair, a replacement drive assembly 32 may be used in the repair interim. This substantially eliminates "down time" of the powered wheelchair apparatus 20 during repair time.

Because wheelchair apparatus 20 is fully operable as a manual wheelchair (FIGURE 2), it may not be a necessary to own both a manual chair in addition a powered chair. For example, for home use or in close confines, power drive assembly 32 may simply be detached from wheelchair frame means 22 and replaced with manually operable wheels 34 and 34'. Accordingly, manually-operable wheelchair apparatus 20 will not unduly wear or harm the rug and floors the way a powered wheelchair may.

Power drive assembly 32 can be seen in FIGURE 3-5, include a drive frame means 36 suitably formed to support motor means, generally designated 38. Motor means 38 is drivably coupled to a pair of powered wheels 40 and 40' which are standard wheels employed by

various powered wheelchairs. In the preferred embodiment, motor means 38 is provided by two motors 39 and 39' (FIGURES 4 and 5) are employed, each of which drives one powered wheel 40 and 40', and each of which are centrally mounted to drive frame means 36. This configuration is especially beneficial in facilitating short radius turns. Each motor 39 and 39' may drive the corresponding powered wheel 40 and 40' in opposite rotational directions which will turn wheelchair apparatus 20 about a much smaller radius.

Motors 39 and 39' are preferably common electric motors generally known in the field. It will be appreciated, however, that a combustion motor or other equivalent device employed to power wheels 40 and 40' could be used without departing from the true spirit and nature of the present invention.

Power drive assembly 32 further includes an electronic controller unit 42 which is operably coupled to a joystick device 44 (FIGURES 1 and 2) mounted proximate seat assembly 24. Accordingly, the user may easily control the operation and direction of wheelchair apparatus 20 from a seated position.

Because two independent motors 39 and 39' are employed by power drive assembly 32, it is also preferable to include two independent batteries 46 and 46' (i.e., one for each motor). As shown in FIGURES 3 and 4, batteries 46 and 46' (preferably encased in battery covers) are mounted to drive frame means 36 on opposite sides of centrally mounted motors 39 and 39'. This mounting symmetry balances most of the weight of drive assembly 32 about a horizontal axis extending through the drive axles 41 and 41'. As will be discussed in more detail below, drive assembly 32 includes adjustments which permit the positioning of drive

assembly 32 relative to the wheelchair frame in a manner allowing the overall center of gravity of the chair to be adjusted. This symmetry of the drive assembly weight also reduces the moment of inertia about a vertical axis, which permits wheelchair apparatus 20 to turn easily at a small turn radii and enables a more controlled turn acceleration, as compared to current commercially available wheelchair assemblies. This considerably facilitates user maneuverability, particularly in small confines.

Furthermore, FIGURE 1 illustrates that power drive assembly 32 is compact and is situated fairly low to the ground relative to wheelchair frame means 22. Because the weight of drive assembly 32 represents a substantial percentage of the overall weight of wheelchair apparatus 20, the cumulative wheelchair apparatus center of gravity (CG) will also be lowered. This configuration (i.e., lowered CG) minimizes lateral tipping of wheelchair apparatus 20 during the above-mentioned small radius turns or the like.

Wheelchair frame means 22 includes two substantially parallel, trapezoidal side frame members 48 and 48' (FIGURES 1 and 2) rigidly coupled together by a cross-bar members 50. Trapezoidal side frame members 48 and 48' and cross-members 50 are preferably hollow rectangular tube structures of sufficient rigidity and thickness to support and carry seat assembly 24 and its passenger. Trapezoidal side frame members 48 and 48' are preferably formed to be positioned adjacent to and on opposite sides of power drive assembly 32 so as to straddle it, as shown in FIGURE 1. This eases mounting and positioning of power drive assembly 32 relative to wheelchair frame means 22.

Power drive assembly 32 is detachably mounted to wheelchair frame means 22 through a mounting assembly, generally designated 52. As best viewed in FIGURES 1 and 6, mounting assembly 52 includes a first mounting element 54 secured by fasteners 55 to an inner side of side frame member 48 and a second mounting element 56 carried by drive frame means 36. Mounting assembly 52' similarly includes a first mounting element 54' and a second mounting element 56'. Both first mounting elements 54 and 54', and corresponding second mounting elements 56 and 56' are convergently tapered in a downward direction and formed for mating nested engagement with one another. Thus, each first mounting element 54 and 54' includes downwardly facing wedge-shaped surface 58 which promotes mounting stability with mating surface 60 of second mounting element 56 and 56'. It will be appreciated that both first mounting element 54 and 54' and second mounting element 56 and 56' could be convergently tapered in a upward direction, with the female receiving element mounted to frame members 48 and 48' and the male elements mounted to frame means 36. Moreover, first mounting element 54 and 54' and second mounting element 56 and 56' could include rounded male-female mating members or pin-and-socket mating members without departing from the true spirit and nature of the present invention.

A threaded fastener 62, as shown in FIGURE 6, permits releasable mounting of first mounting element 54 to corresponding second mounting element 56. Fastener 62 preferably includes a bolt portion 64 extending through first mounting element 54. Bolt portion 64 is received in a corresponding threaded opening 66 provided in an upward facing surface 68 of second mounting element 56. Virtually any quick release fastener may be employed, however. When bolt portion 64 is threadably fastened in opening 66, the downwardly facing wedge-shaped

surface 58 of first mounting element 54 matingly engages the upwardly facing mating surface 60 of second mounting element 56. Accordingly, mounting assembly 52 provides an accurate, rigid, yet quick release mounting method of power drive assembly 32 to wheelchair frame means 22.

FIGURE 6 further illustrates that each second mounting element 56 and 56' may be situated at a plurality of positions along the sides of drive frame means 36. A plurality of alignment bores 70 extend through a side portion of each second mounting element 56 and 56'. Alignment of selective alignment bores 70 with corresponding mounting holes (not shown) extending through drive frame means 36 permit second mounting element 56 and 56' to moved between a fore and an aft portion relative to drive frame means 36. Alignment fasteners 72 are used to releasably mount second mounting elements 56 and 56' to drive frame means 36. Adjusting second mounting elements 56 and 56' between the fore and the aft portion of drive frame means 36 allows favorable positioning of power drive assembly 32 relative to the vertical axis extending through the combined wheelchair center of gravity. In turn, the moment of inertia about such vertical axis can be minimized to facilitate turning acceleration, as mentioned above.

Turning now to FIGURES 4 and 5, spacers 74 and 74' may be provided, of varying thickness, between drive frame means 36 and second mounting elements 56 and 56'. Spacers 74 and 74' position second mounting elements laterally outward from drive frame means 36. This permits precise alignment of second mounting element 56 and 56' with the corresponding first mounting element 54 and 54' for wheelchair frame means 22 having different width dimensions, i.e., cross-members 50 of

differing length. Thus, the detachable power drive assembly of the present invention can be mounted to wheelchairs of customized width simply by changing spacers 74 and 74'.

In accordance with the present invention, power drive assembly 32 may be detached from wheelchair frame means 22, as a unit, and wheelchair apparatus 20 may be operated as a manually powered wheelchair. As best shown in FIGURE 2, a pair of preferably 24" diameter manually-operable wheels 34 and 34' are releasably mounted to wheelchair frame means 22. Manual wheel mounting passageways 76 and 76' are provided proximate the aft portions of each trapezoidal side frame member 48 and 48'. Mounting passageways 76 and 76' are dimensioned to releasably receive the axle portions 75' of manually-operable wheels 34 and 34'. In the preferred form, wheels 34 and 34' include quick release hubs 78 and 78' commonly known in the field which provide quick release of wheels 34 and 34' from mounting passageways 76 and 76'.

Mounting passageways 76 and 76' are positioned vertically on trapezoidal frame members 48 and 48' at a level which preferably positions seat assembly 24 at a height substantially similar to the seating height when drive assembly 32 is mounted to wheelchair frame means 22. It is noted that the vertical positioning of mounting passageways 76 and 76' could be adjustable so as to accommodate different diameter manually-operable wheels, if desired. Similarly, the fore and aft positioning of mounting passageways 76 and 76' along trapezoidal frame members 48 and 48' is selected to position the manually-operable wheels 34 and 34' at substantially the same location as powered-wheels 40 and 40' of drive assembly 32. This assures that the mobility characteristics between the powered wheelchair

apparatus and the manually operable wheelchair apparatus are not radically different. It also will be understood that a plurality of fore and aft locations for passageways 76 and 76' could be provided.

In another aspect of the present invention, it is recognized that angular acceleration of power driven wheels 40 and 40' can cause wheelchair apparatus 20 to tip rearward. Thus, an anti-tip suspension, generally designated 80, is provided which non-linearly resists rearward tipping of wheelchair apparatus 20 during abrupt accelerations. As best viewed in FIGURES 3 and 7, anti-tip suspension, generally designated 80, includes a pair of suspension arm assemblies 84 and 84' pivotally mounted to opposite sides of drive frame means 36. Although preferably two independent suspension arm assemblies 84 and 84' are provided, it will be understood that a single suspension arm assembly 84 may adequately provide the desired variable rate resistance necessary to provide a suspension function and an anti-tipping function. Moreover, it is noted that anti-tip suspension 80 can be pivotally mounted to wheelchair frame means 22 rather than drive frame means 36 without departing from the true spirit and nature of the present invention. For brevity, only one suspension arm assembly 84 will be described in detail.

Suspension arm assembly 84 is formed to provide a variable rate resistance to displacement which progressively increases as suspension 80 increasingly engages the ground 82. When suspension arm assembly 84 is vertically compressed, as shown in phantom lines in FIGURE 7, the resistance rate of suspension 80 increases non-linearly further resisting rearward tipping. This configuration has been found to provide a smooth transitional force opposing tipping. The

nonlinear resistance eliminates the abrupt stops or sever jolts commonplace in the prior art anti-tipping devices provided. Furthermore, the force returning wheelchair 20 to its normal stable position, with front caster wheels 30 on ground 82, also decreases non-linearly so as not to throw or launch the occupant forward as front caster wheels 30 once again engage ground 82. Accordingly, the present invention effectively resists rearward tipping and gently returns wheelchair 20 to its normal operating position. By comparison, the relatively rigid cantilever-type anti-tip designs of the prior art are not specifically designed for progressive resistance and generally are formed merely as anti-tipping stops. Engagement, upon rearward tipping, with these devices is often abrupt and jolting to the user.

Moreover, and very importantly, the variable resistance feature allows arm 84 to support wheel 94 very close to support surface 82, as best seen in FIGURE 7. This positioning, less than one inch above support surface 82 could not be tolerated if arm 84 were rigidly mounted to the wheelchair. The resilient, nonlinear support of arm 84, however, allows it to have a ground engaging means, such as a wheel 94, positioned close to the ground so as to almost immediately start to resist tipping with an initially low force that increases with increased displacement. This smooths the resistance to tipping so as to reduce jolting and jarring of the rider. Moreover, small bumps and undulations in support surface 82 can be easily accommodated by displacement of wheel 94 and arm 82 upwardly against a resistance force that is relatively low during initial arm displacement and increases smoothly if large displacements occur.

As best shown in FIGURES 1 and 3, suspension arm assemblies 84 and 84' are preferably positioned proximate the aft portion of drive frame means 36. Suspension arm assembly 84 includes a first or pivotal arm portion 86 extending downward and away from, and mounted for pivotal movement about, a first stationary mount or pivot pin 88. A second or sliding arm portion 90 extends away from first stationary mount 88 in the aft direction, and includes a flexible apex or knee portion 92 extending from the upper end of pivotal arm portion 86 proximate first stationary mount 88. Accordingly, sliding arm portion 90 and pivotal arm portion 86 diverge from knee portion 92 forming a V-shaped suspension arm assembly 84 with each arm portion defining one side of the V. A ground engaging wheel 94 preferably is rotatably mounted to the lower end of pivotal arm portion 86.

Suspension 80 is movably mounted about two stationary mounts which are secured to drive frame means 36. The first stationary mount 88, already described above, provides pivotal displacement of pivotal arm portion 86 about first stationary mount 88. A second stationary mount 96 is positioned proximate an upper end of sliding arm portion 90 opposite knee portion 92. Second stationary mount 96 is formed and dimensioned to slidingly engage a slot 100 provided in the upper end of sliding arm portion 90. Slot 100 extends longitudinally along sliding portion 86 and is formed to prevent rotation of sliding arm portion 90 about first stationary mount 88. However, slot 100 permits sliding translational movement of sliding arm portion 90 relative to second stationary mount 96 for the reasons to be described henceforth.

In accordance with the present invention, suspension arm assembly 84 non-linearly and progressively

increases resistance against rearward tipping as the end portion of pivotal arm portion 86 vertically displaces relative to sliding arm portion 90. As shown in phantom lines in FIGURE 7, V-shaped suspension arm assembly 84 is resiliently flexible about knee portion 92. This resilient flexibility permits substantial vertical displacement of the lower end portion of pivotal arm portion 86 when ground engaging caster wheel 94 engages ground 82. Knee portion 92 includes a flexibility opening 102 extending substantially horizontally through knee portion 92. Opening 102 provides greater flexibility and more displacement of pivotal arm portion 86 about first stationary mount 88.

An upward facing cam surface 104 is provided on pivotal arm portion 86 which is positioned to engage an opposing contact surface 106 on sliding arm portion 90. As shown in the phantom lines of FIGURE 7, during substantial upward displacement of pivotal arm portion 86 about first stationary point mount or pin 88 (e.g., when wheelchair apparatus 20 is tipped substantially rearward), cam surface 104 is drawn into rockable contact with opposing contact surface 106. The initial contact between cam surface 104 and opposing contact surface 106 occurs proximate pivot pin 88 so that the resistance to flexing of knee portion 92 is relatively low. However, as cam surface 104 increasingly engages opposing contact surface 106, the curvature of cam surface 106 causes the contact to occur at a greater radial distance from pivot pin 88 which, further, causes sliding arm portion 90 to slightly bow. This increases the resistance to upward pivoting in a non-linear manner. Furthermore, pivoting of suspension arm 84 about first stationary mount 88 also causes sliding translational movement of sliding arm portion 90, via slot 100, with respect to second stationary mount 96. Thus, the above-mentioned combination of conditions

culminate to provide a non-linearly increasing resistance force against rearward tipping.

Because it is desirable for sliding arm portion 90 to slightly bow or flex as cam surface 104 increasingly engages contact surface 106, sliding arm portion 90 is preferably composed of a material slightly more resilient or flexible than pivotal arm portion 86. Therefore, although suspension arm assembly 84 is preferably a unitary structure, sliding arm portion 90, pivotal arm portion 86 and knee portion 92 may be composed a combination of different resilient semi-flexible materials. For example, composite plastics or the like are particularly suitable. In this manner, the non-linear resistance can be programmed for a particular use. Moreover, the cross-sectional configurations and dimensions of sliding arm portion 90, pivotal arm portion 86 and knee portion 92 may be varied to program the desired non-linear resistance properties.

In still another aspect of the present invention, a wheel lock assembly, generally designated 108, is provided to effect locking of manually-operable wheels 34 and 34' during manual operation of wheelchair apparatus 20 (i.e., when power drive assembly 32 is detached). In accordance with the present invention, wheel lock assembly 108 is mounted for movement between a "deployed" operable position (FIGURE 8) and a "stored" inoperable position (FIGURE 9). It will be understood that the "deployed" position represents the orientation of wheel lock assembly 108 in which it may be extended into frictional engagement with the corresponding manually-operable wheel 34 to effect locking thereof. In this orientation, wheel lock assembly 108 may be moved between one of two positions. The first "deployed" position corresponds to a non-

locking position (shown in solid lines in FIGURE 8) which is free of frictional engagement with manually-operable wheels 34 and 34'. The second "deployed" position (shown in phantom lines) corresponds to a locking position in which wheel lock assembly 108 is extended to effect locking of manually-operable wheels 34 and 34'. Thus, the "deployed" position is typical of the standard, fixed orientation of the wheel lock assemblies employed on most prior art wheelchair assemblies.

In contrast, the "stored" position (FIGURE 9) of the present invention corresponds to an orientation which places wheel lock assembly 108 out of reach and stowed for non-use. This stowed position is particularly useful when power drive assembly 32 is attached to wheelchair frame means 22 and manually-operable wheels 34 and 34' are dismounted therefrom. Because wheel lock assembly 108 is inoperable to effect locking when wheelchair apparatus 20 is arranged to be power driven, manual wheel lock assembly 108 is a potential nuisance in some instances. Accordingly, it is preferable to reposition wheel lock assembly 108 out of operable use.

Wheel lock assembly 108 includes a first mounting member 110 carrying a wheel engaging means 112 mounted on one end thereof which is suitably formed for frictional engagement with manually-operable wheel 34. Wheel engaging means 112 is similar to most common manual wheel locks employed in the industry. A second mounting member 114 is rigidly fixed to wheelchair side frame means 48 proximate an upper cross-frame member 50. (Note that the wheelchair is reversed in position in FIGURES 8-10 from the position of FIGURES 1 and 2.) Mounting member 114 is formed and dimensioned for sliding rotatable engagement with first mounting member 110. This arrangement permits first mounting member

110 to be rotatably positioned in either the "deployed" position (FIGURE 8) and the "stored" position (FIGURE 9).

First mounting member 110 includes a post member 116 formed to extend laterally along wheelchair frame means 22. Second mounting member 114 is preferably a sleeve-like member providing a post receiving opening 118 which is formed and dimensioned to slidably receive an end of post member 116. Accordingly, post member 116 is telescopically mounted for pivotal movement relative to opening 118 between the "stored" inoperable position and the "deployed" operable position. It will be appreciated that the post member/receiving opening arrangement between first mounting member 110 and second mounting member 114, respectively, may be reversed without departing from the true spirit and nature of the present invention.

An alignment slot 120 is provided proximate the distal end of post member 116, as best shown in FIGURES 9 and 10. Alignment slot 120 is formed and dimensioned to slidably receive an alignment bar 122 positioned inside post receiving opening 118. The proper positioning and interengagment between alignment slot 120 and alignment bar 122 orient wheel lock assembly 108 in either the "deployed" position or the "stored" position. As post member 116 is telescopically received in opening 118, wheel lock assembly 108 is approximately positioned in either the "deployed" position or the "stored" position wherein alignment slot 120 will matingly engage and receive alignment bar 122 provided in bore 118 and extending transversely thereacross. It is noted that the "stored" position is preferably rotated approximately 180 Degrees from the "deployed" position. Upon interengagement therebetween, wheel lock assembly

108 will be more precisely aligned in one of the above-mentioned positions.

As shown in FIGURES 9 and 10, a quick-release locking pin 124 releasably locks post member 116 relative to receiving opening 118 in either the "deployed" position or the "stored" position. Hence, alignment bar 122 will not inadvertently disengage from alignment slot 120 so that first mounting member 110 is free to pivot about second mounting member 114. In the preferred form, complimentary locking bores 126 are provided in and extend through both post member 116 and sleeve-shaped second mounting member 114. Locking bores 126 are formed and dimensioned to receive locking pin 124, and are positioned to cooperate with the alignment slot/bar to releasably lock wheel lock device 108 in either the "stored" or the "deployed" position. After locking pin 124 has been inserted through locking bores 126, the positioning of post member 116 relative to receiving opening 118 will be releasably preserved.

In an alternative embodiment of wheel lock assembly 108, a retaining spring member 128 is coupled between telescopically mounted post member 116 and post receiving opening 118, as viewed in FIGURE 10. Retaining spring member 128 resiliently retains post member 116 telescopically mounted relative to opening 118 to facilitate interengagement between alignment slot 120 and alignment bar 122 before locking pin 124 is inserted into locking bores 126. Retaining spring member 128 is preferably a coil-type tension spring having one end coupled to alignment bar 122 and the opposing end mounted inside post member 116. Spring member 128 is formed to permit pivotal movement of post member 116 relative to post receiving opening 118.

While the invention has been described in connection with what is presently considered to be the most practical and preferred embodiments, it is to be understood that the invention is not limited to the disclosed embodiment but, on the contrary, is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims.

Therefore, persons of ordinary skill in this field are to understand that all such equivalent structures are to be included within the scope of the following claims.

WHAT IS CLAIMED IS:

1. A wheelchair comprising:

wheelchair frame means having a fore portion and an aft portion;

a seat assembly carried by said wheelchair frame means;

a power drive assembly including a drive assembly frame means, motor means mounted to said drive assembly frame means, and power drive wheels mounted to said drive assembly frame means and operably coupled to said motor means;

drive assembly mounting means releasably coupling said drive assembly frame means to said wheelchair frame means proximate said aft portion for driving of said wheelchair as a powered wheelchair and for selective removal of said power drive assembly as a unit from said wheelchair frame means; and

wheel mounting means releasably receiving a pair of manually-operable drive wheels for mounting to said wheelchair frame means when said power drive assembly is removed from said wheelchair frame means for operation of said wheelchair as a manually-powered wheelchair.

2. The wheelchair as defined in claim 1 wherein,

said wheel mounting means is positioned proximate said aft portion of said wheelchair frame means.

3. The wheelchair as defined in claim 1 wherein,

said motor means is an electric motor, and

battery means mounted to said drive assembly frame means and electrically connected to said motor means.

4. The wheelchair as defined in claim 1 wherein,

said power assembly mounting means includes a first mounting element carried by said wheelchair frame means, a second mounting element carried by said drive

assembly frame means and fastener means releasably coupling said first mounting element to said second mounting element.

5. The wheelchair as defined in claim 4 wherein,

said first mounting element and said second mounting element are formed for mating nested engagement.

6. The wheelchair as defined in claim 5 wherein,

said first mounting element and said second mounting element are convergently tapered in a downward direction, and

said fastener means is provided by a threaded fastener carried by said first mounting element and threadably received by said second mounting element.

7. The wheelchair as defined in claim 4 wherein,

said second mounting element includes positioning means for coupling said second mounting element to said drive assembly frame means at positions changing the location of a center of gravity of said drive assembly relative to said wheelchair frame means.

8. The wheelchair as defined in claim 7 wherein,

said positioning means is formed for coupling said second mounting element at one of a plurality of positions.

9. The wheelchair as defined in claim 8 wherein,

said positioning means includes a plurality of apertures extending through said second mounting element.

10. The wheelchair as defined in claim 1 wherein,

said wheelchair frame means includes a pair of spaced apart side frame members straddling said power drive assembly.

11. The wheelchair as defined in claim 10 wherein,

said power assembly mounting means includes a first mounting element carried by each of said side frame members, a pair of second mounting elements carried by opposite sides of said drive assembly frame means, and fastener means releasably coupling said first mounting element to a respective second mounting element.

12. The wheelchair as defined in claim 11 wherein,

said first mounting element and said second mounting element are formed for mating nested engagement.

13. The wheelchair as defined in claim 12 wherein,

said power drive assembly includes spacer means mounted between said drive assembly frame means and said second mounting element for laterally aligning each of said second mounting elements with respective first mounting elements.

14. The wheelchair as defined in claim 1 further including:

anti-tip suspension means mounted to one of said aft portion of said wheelchair frame means and said drive assembly frame means for preventing rearward tipping of said wheelchair.

15. The wheelchair as defined in claim 14 wherein,

said anti-tip suspension means includes a suspension arm assembly, and mounting means pivotally mounting said arm assembly to said drive assembly frame means; and

said arm assembly having a first arm portion extending away from said mounting means;

ground engaging means provided on said first arm portion at a spaced distance from said mounting means; and

said arm assembly further including pivotal motion resisting means resisting pivoting of said first arm portion about said mounting means when said wheelchair is tipped by an amount sufficient to cause said ground engaging means to contact the ground.

16. The wheelchair as defined in claim 15 wherein,

said pivotal motion resisting means resists pivoting of said first arm portion about said mounting means with a nonlinear resistance force.

17. The wheelchair as defined in claim 15 wherein,

said pivotal motion resisting means is provided by a second arm portion on said arm assembly coupled to said first arm portion.

18. The wheelchair as defined in claim 17 wherein,

said second arm portion and said first arm portion extend away from opposed sides of said mounting means.

19. The wheelchair as defined in claim 18 wherein,

said second arm portion is secured proximate a distal end thereof to said drive assembly frames means and is further formed for resilient flexing thereof intermediate said distal end and said mounting means to resiliently resist rotation of said first arm portion.

20. The wheelchair as defined in claim 19 wherein,

said second arm portion is secured proximate said distal end for sliding translational movement.

21. The wheelchair as defined in claim 19 wherein,

said first arm portion and said second arm portion are formed for cooperative engagement after a predetermined rotation of said first arm portion to progressively increase the resistance to further rotation of said first arm portion.

22. The wheelchair as defined in claim 1 and,

wheel lock means carried by said wheelchair frame means and formed to engage said manually-operable drive wheels to effect braking thereof; and

said wheel lock means being movably mounted to said wheelchair frame means for movement between a stored inoperable position, when said power drive assembly is coupled to said wheelchair frame means, and a deployed operable position, when said power drive means is removed from said wheelchair frame means and said manually-operable drive wheels are mounted to said wheelchair frame means.

23. The wheelchair as defined in claim 22 wherein,

said wheel lock means extends laterally outwardly of said frame means, when in said deployed operable position, by an amount enabling frictional engagement by said wheel lock with one of said manually-operable drive wheels to effect braking thereof, and extends laterally inwardly of said frame means, when in said stored inoperable position.

24. The wheelchair as defined by claim 23 wherein,

said wheel lock means includes a first mounting member having manually-operable drive wheel engaging means carried by one end thereof, and a second mounting member secured to said wheelchair frame means, and said first mounting member and said second mounting member being relatively formed and dimensioned for and mounted in sliding rotatable engagement.

25. The wheelchair as defined by claim 24 further including:

locking means for locking said first mounting member relative to said second mounting member in said stored inoperable position and in said deployed operable position.

26. An anti-tip suspension for a wheelchair having a frame means, said anti-tip suspension comprising:

a suspension arm assembly having mounting means for pivotally mounting said arm assembly to said frame means and having a first arm portion extending away from said mounting means;

ground engaging means provided on said first arm portion at a spaced distance from said mounting means; and

said arm assembly further including pivotal motion resisting means resisting pivoting of said first arm portion about said mounting means when said wheelchair is tipped by an amount sufficient to cause said ground engaging means to contact the ground.

27. The anti-tip suspension as defined in claim 26 wherein,

said pivotal motion resisting means resists pivoting of said arm about said mounting means with a nonlinear resistance force.

28. The anti-tip suspension as defined in claim 26 wherein,

said pivotal motion resisting means is provided by a second arm portion on said arm assembly coupled to said first arm portion.

29. The anti-tip suspension as defined in claim 28 wherein,

said second arm portion and said first arm portion extend away from opposed sides of said mounting means.

30. The anti-tip suspension as defined in claim 29 wherein,

said second arm portion is formed for securement proximate a distal end thereof to said frames means and is further formed for resilient flexing thereof intermediate said distal end and said mounting means to resiliently resist rotation of said first arm portion.

31. The anti-tip suspension as defined in claim 30 wherein,

said second arm portion further is formed to be positioned for engagement by said first arm portion after a predetermined rotation of said first arm portion to substantially progressively increase the resistance to further rotation of said first arm portion.

32. The anti-tip suspension as defined in claim 31 wherein,

one of said first arm portion and said second arm portion are formed with a cam surface producing progressively greater rotation resistance force in said second arm portion.

33. The anti-tip suspension as defined in claim 26 wherein,

said arm assembly is provided by a V-shaped member having an apex and with said first arm portion providing one side of said V-shaped member extending away from said apex and a second arm portion providing a second side of said V-shaped member extending away from said apex.

34. The anti-tip suspension as defined in claim 33 wherein,

said mounting means is provided in said first arm portion proximate said apex of said V-shaped member.

35. The anti-tip suspension as defined in claim 34 wherein,

said apex of said V-shaped member is resiliently flexible, and

said second arm portion is formed for securement against rotation about said mounting means.

36. The anti-tip suspension as defined in claim 35 wherein,

said second arm portion is formed for sliding movement transverse to the direction of rotation of said first arm portion.

37. The anti-tip suspension as defined in claim 33 wherein,

said first arm portion and said second arm portion are formed from a moldable material and are integrally molded together.

38. The anti-tip suspension as defined in claim 37 wherein,

said second arm portion is slotted proximate an end remote from said mounting means to receive a member limiting rotation of said second arm portion while permitting sliding translation.

39. The anti-tip suspension as defined in claim 38 wherein,

said second arm portion is positioned sufficiently close to said first arm portion for contact therebetween upon rotation of said first arm portion about said mounting means.

40. The anti-tip suspension as defined in claim 39 wherein,

one of said first arm portion and said second arm portion are provided with a cam surface positioned to engage the other of said first arm portion and said second arm portion at a distance which progressively is farther from said mounting means as said first arm portion is rotated by an increasing amount about said mounting means.

41. A wheelchair and anti-tip suspension comprising:

a wheelchair having frame means;

an anti-tip suspension arm assembly mounted to said frame means proximate a rear of said wheelchair by mounting means, said arm assembly having a first arm portion extending away from said mounting means;

ground engaging means provided on said first arm portion at a spaced distance from said mounting means; and

said arm assembly further including motion resisting means resisting displacement of said first arm portion about said mounting means by a progressively increasing resistance force when said wheelchair is tipped by an amount sufficient to cause said ground engaging means to contact the ground.

42. The wheelchair and anti-tip suspension as defined in claim 41 wherein,

said mounting means includes pivotal mounting means coupling said first arm portion to said frame means, and

said motion resisting means is provided by a second arm portion coupled to said first arm portion proximate one end of said second arm portion and coupled to said frame means proximate an opposite end thereof.

43. The wheelchair and anti-tip suspension as defined in claim 42 wherein,

said second arm portion is resiliently flexible between said opposite end and coupling to said first arm portion, and

said second arm portion is positioned for engagement by said first arm portion to produce said progressively increasing resistance force.

44. In a wheel lock assembly for a wheelchair, said wheelchair including wheelchair frame means and a pair of drive wheels mounted to said wheelchair frame means, said wheel lock assembly formed to engage at least one of said wheels to effect braking thereof, the improvement in said wheel lock assembly comprising:

said wheel lock assembly is mounted to said wheelchair frame means for movement between a stored inoperable position and a deployed operable position.

45. The wheel lock assembly as defined by claim 44 wherein,

said wheel lock assembly is mounted for movement between said deployed operable position extending laterally outwardly of said frame means by an amount enabling frictional engagement by said wheel lock with one of said manually-operable drive wheels to effect braking thereof, and said stored inoperable position located laterally inwardly of said frame means.

46. The wheel lock assembly as defined by claim 45 wherein,

said wheel lock assembly includes a first mounting member having manually-operable drive wheel engaging means carried by one end thereof, and a second mounting member secured to said wheelchair frame means, and said first mounting member and said second mounting member

being relatively formed and dimensioned for and mounted in sliding rotatable engagement.

47. The wheel lock assembly as defined by claim 46 wherein,

said first mounting member is formed as one of post means and sleeve means and said second mounting member is formed as the corresponding other post means and sleeve means, and said post means and sleeve means are mounted for pivotally movement relative said sleeve member between said stored inoperable position and said deployed operable position.

48. The wheel lock assembly as defined by claim 46 further including:

locking means for locking said first mounting member relative to said second mounting member in said stored inoperable position and in said deployed operable position.

49. The wheel lock assembly as defined by claim 46 further including:

retaining means coupled between said first mounting member and said second mounting member for resiliently retaining said first mounting member and said second mounting member in said sliding rotatable engagement.

50. The wheel lock assembly as defined by claim 49 wherein,

said retaining means includes spring means biased in a retracted position and having one end coupled to said first mounting member and an opposing end coupled to said second mounting member.

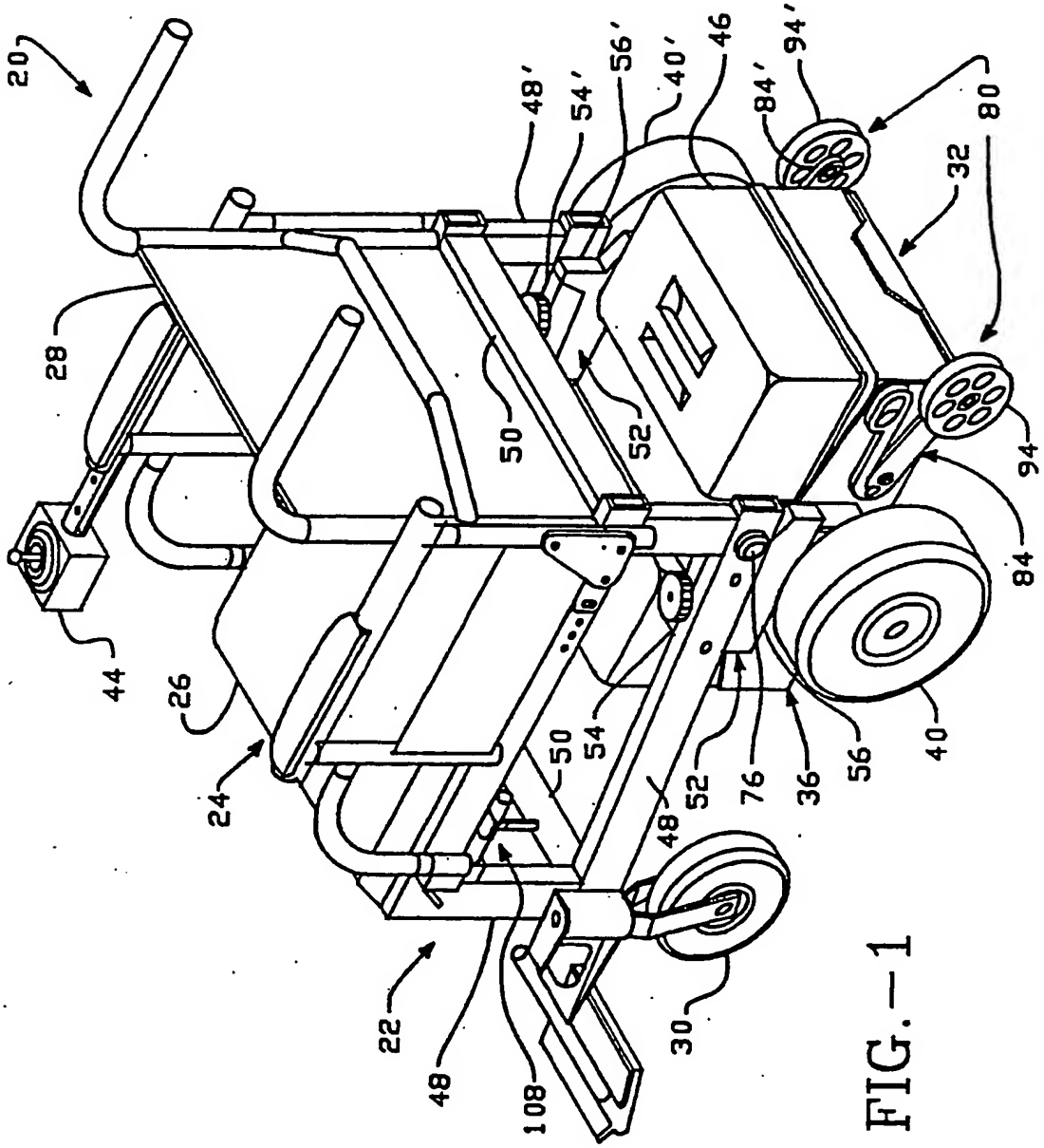
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FIG.—1

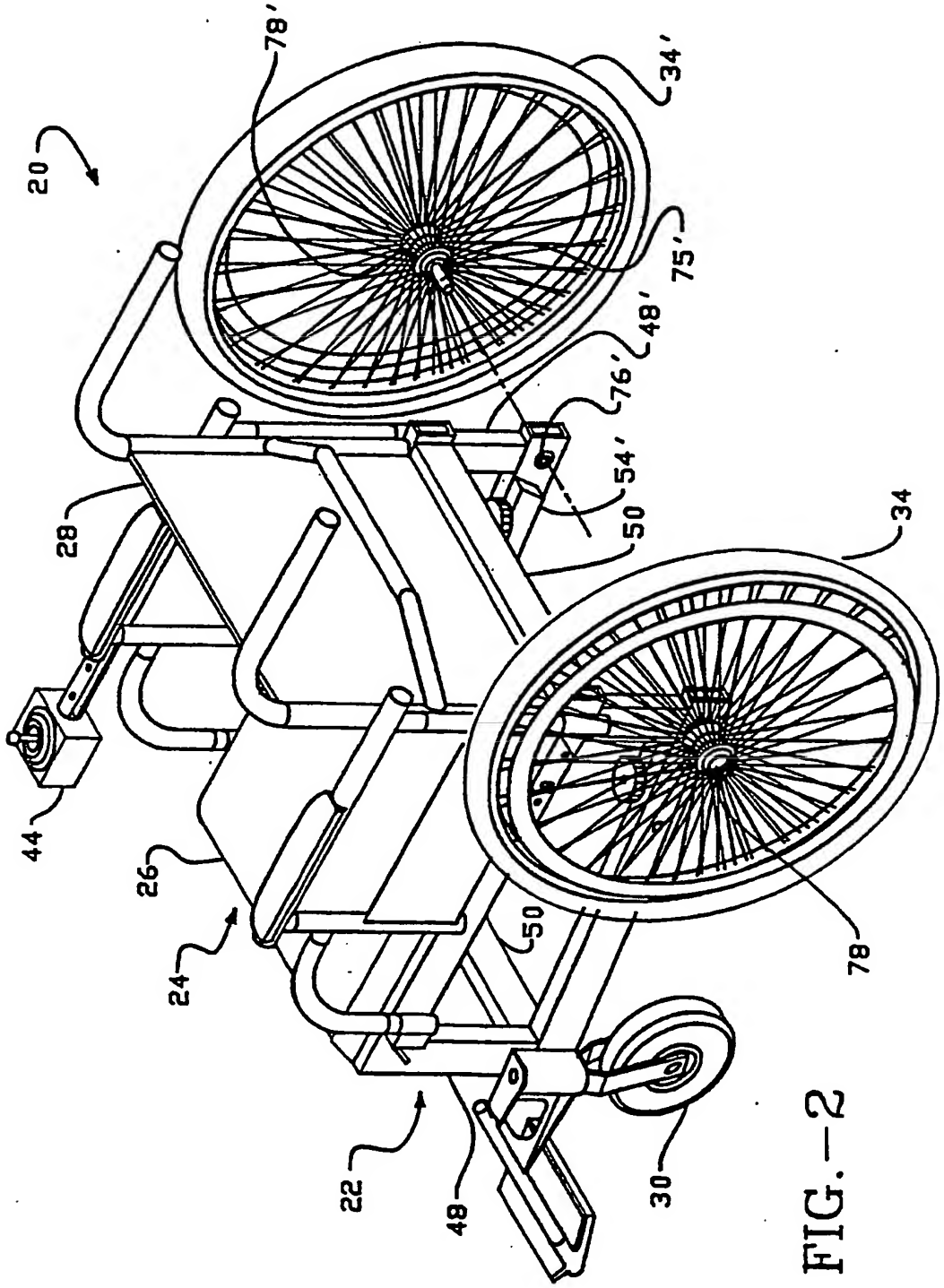

FIG.—2

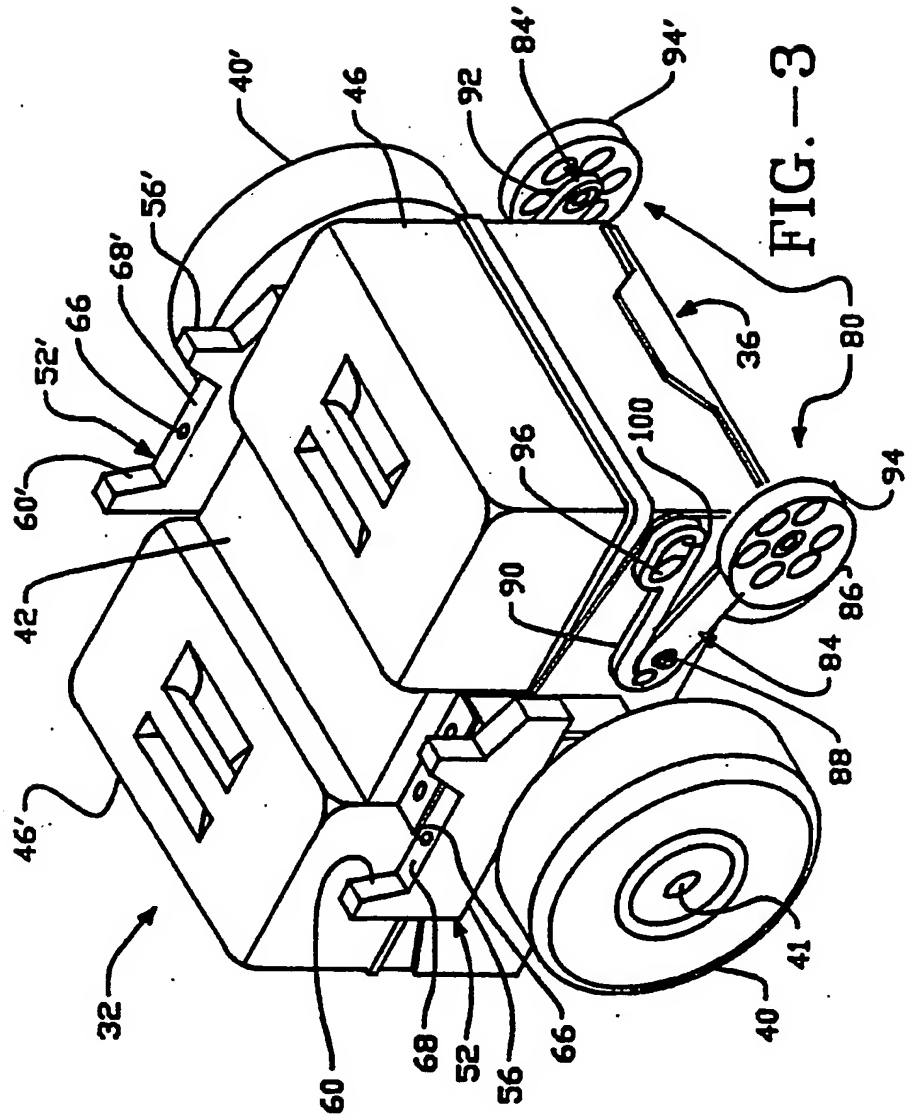
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FIG.—3

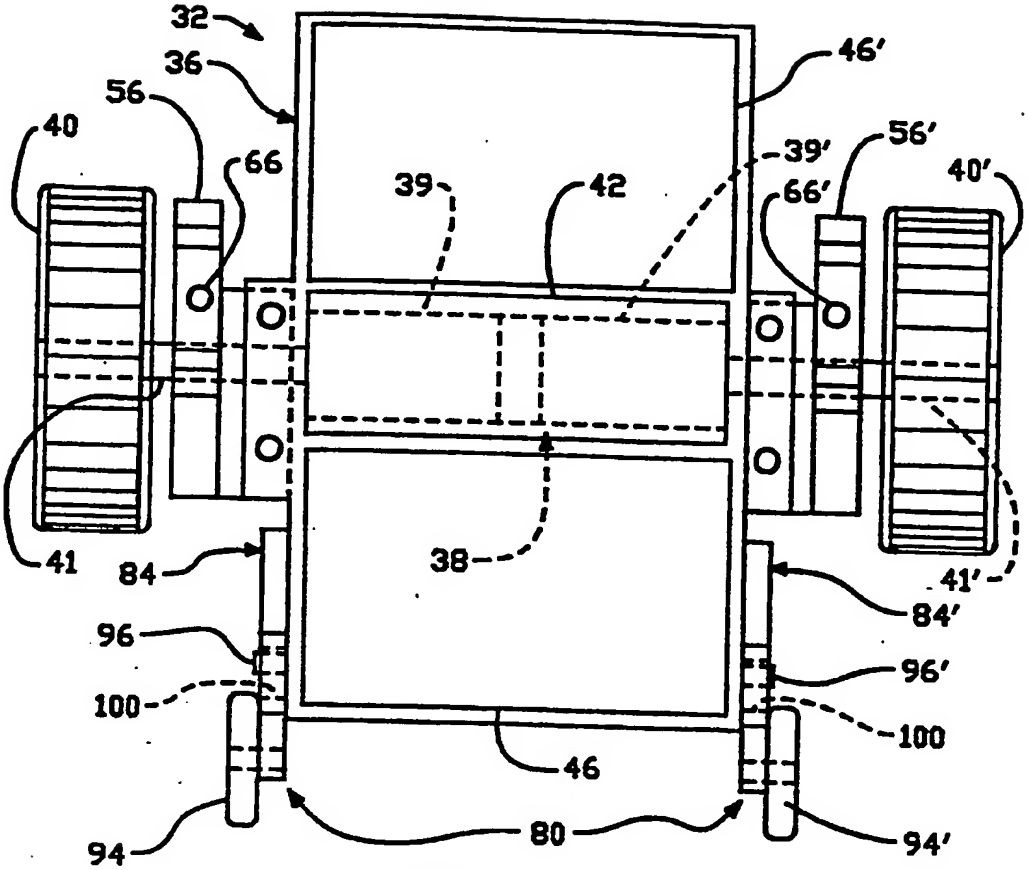
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FIG.—4

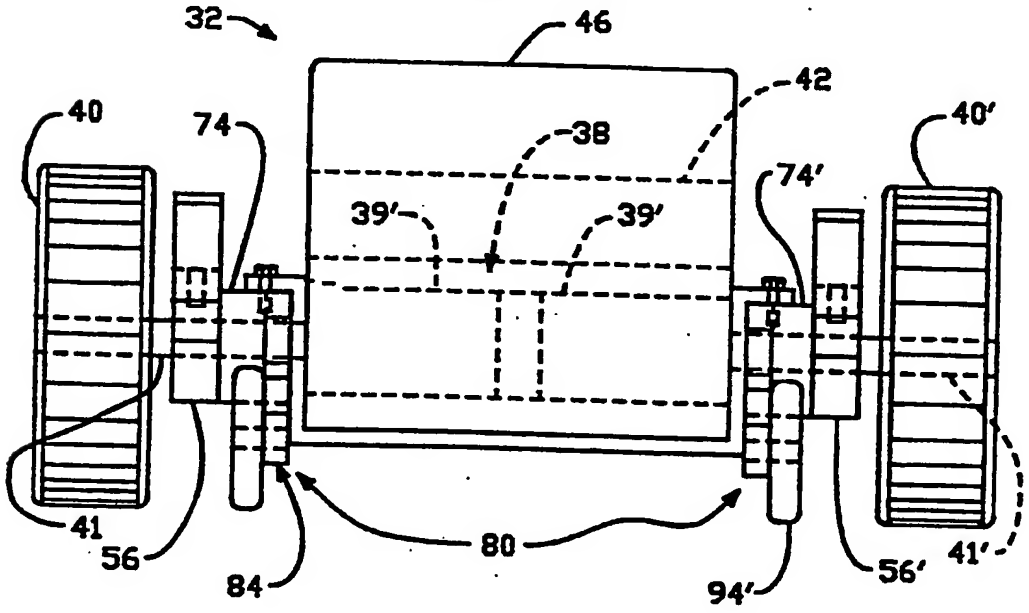
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FIG.—5

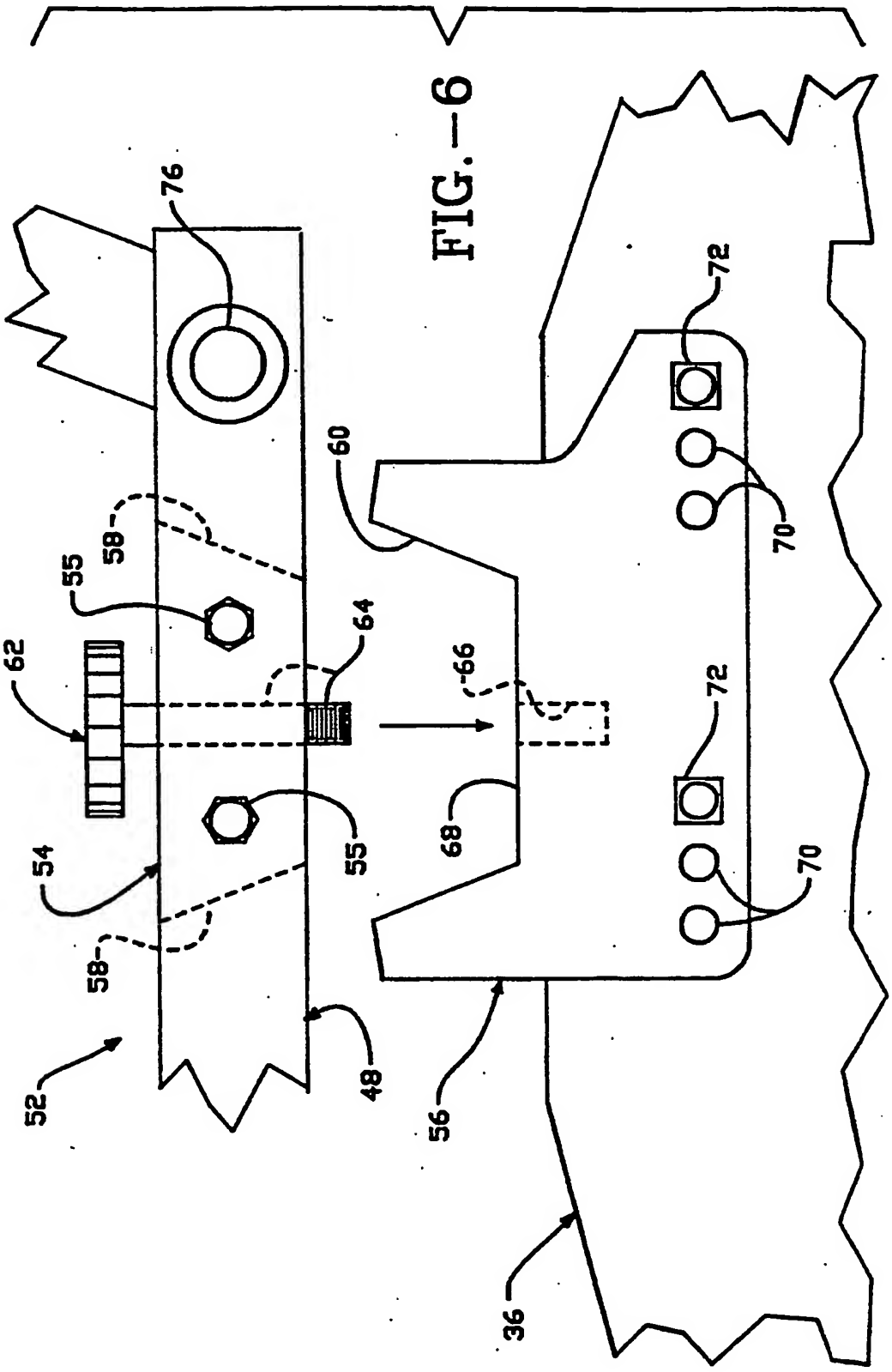

FIG.—6

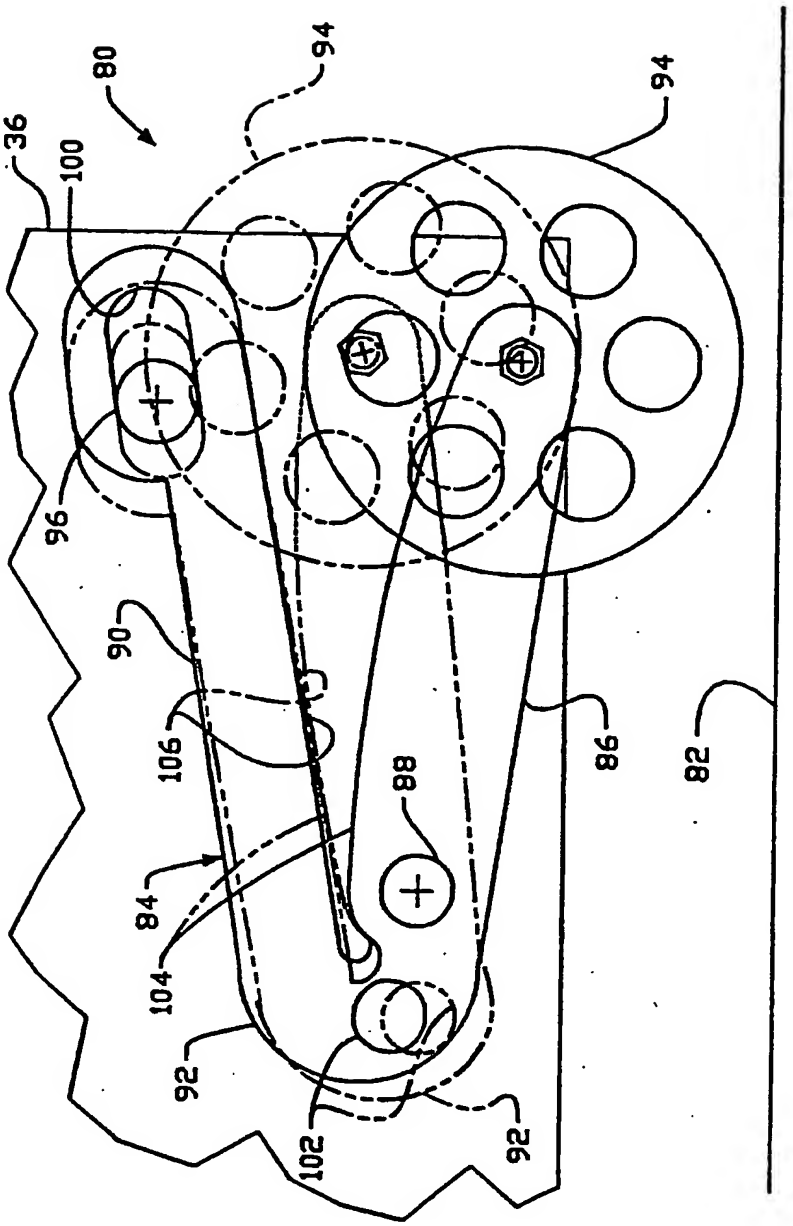

FIG.—7

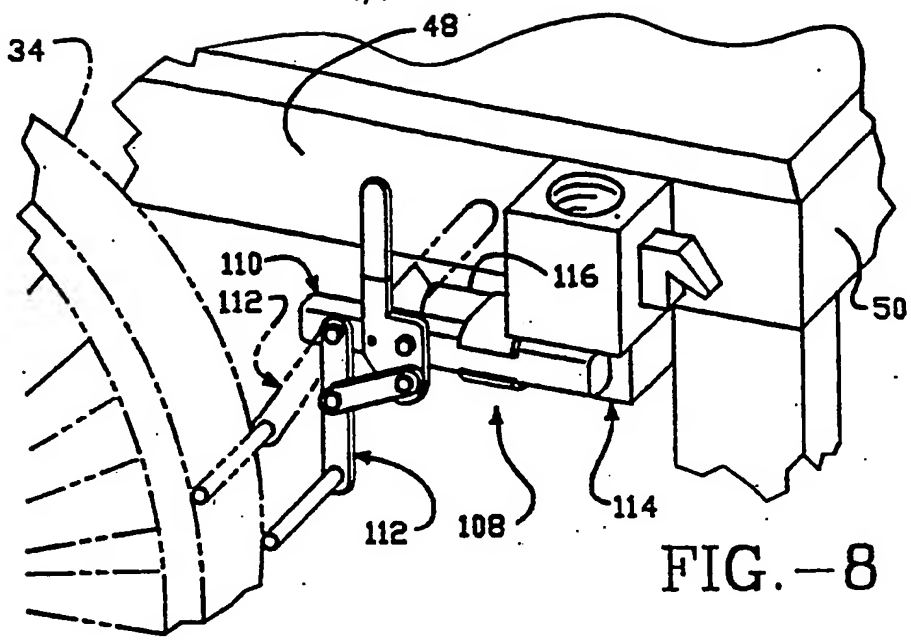

FIG.—8

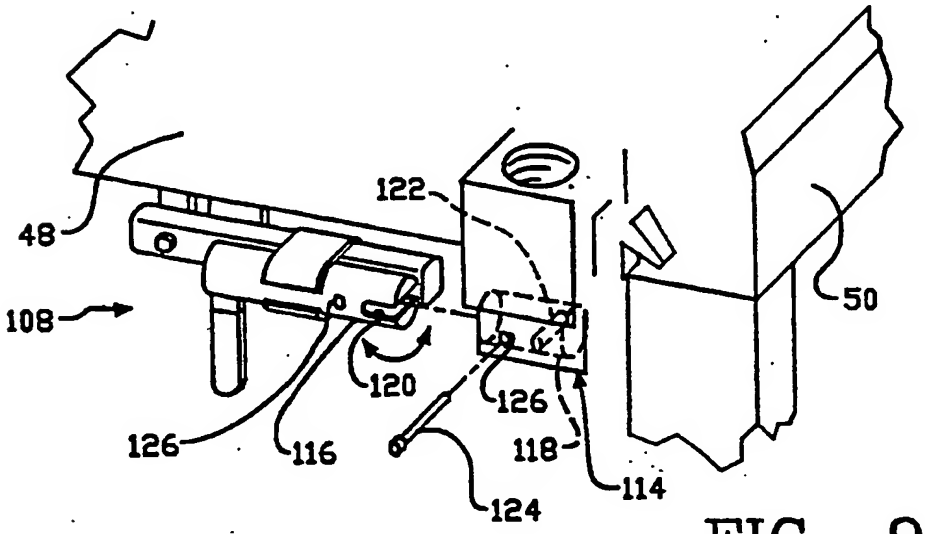

FIG.—9

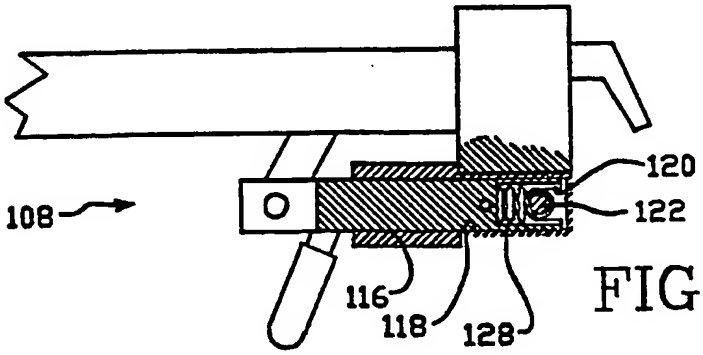

FIG.—10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US93/04676

A. CLASSIFICATION OF SUBJECT MATTER

IPC(5) :B60K 1/00
US CL :180/65.1

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 180/65.1, 11, 907; 280/250.1, 304.1, 30, 699, 700, 718, 721; 188/2F; 403/381; 267/229, 165, 158, 262, 46, 45, 43, 41

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X — Y	US, A, 2,495,573 (Duke) 24 January 1950, see entire document	1-4, 7-11 — 6, 12-14, 22
Y	US, A, 3,100,547 (Rosenthal) 13 August 1963, see entire document	5, 12-13
Y	US, A, 4,475,613 (Walker) 09 October 1984, see col. 3, lines 9-12	14, 41
X — Y	US, A, 4,570,756 (Minnebraker et al) 18 February 1986, see Figures 11-15	44-50 --- 22
X	DE, A, 2,220,119 (Volkswagenwerk AG) 31 October 1973, see Figures 1-2	26-27

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be part of particular relevance

"E" earlier document published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
17 August 1993	19 AUG 1993
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. NOT APPLICABLE	Authorized officer ERIC CULBRETH Telephone No. (703) 308-0360

Form PCT/ISA/210 (second sheet)(July 1992)*

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US93/04676

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X — Y	US, A, 1,559,101 (House) 27 October 1925, see Figure 2	26-29, 33, 37 ——— 41
A	US, A, 2,448,992 (Love et al) 07 September 1948, see entire document	1-25
A	US, A; 5,135,063 (Kropf) 04 August 1992, see entire document	1-25

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US93/04676

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

I. Claims 1-25, drawn to a wheelchair with optional drive means and manually operable wheels, classified in class 280, subclass 30.

II. Claims 26-43, drawn to an anti-tip suspension for a wheelchair, classified in class 280, subclass 699.

III. Claims 44-50, drawn to a wheel lock assembly for a wheelchair, classified in class 188, subclass 2F.

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☒ No protest accompanied the payment of additional search fees.